Marine Biology 98, 597–600 (1988)

Marine Biology
International Journal on Life in Oceans and Coastal Waters

Biology of the conger eel *Conger oceanicus* in the Mid-Atlantic Bight

II. Foods and feeding ecology

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Abstract

In the Mid-Atlantic Bight, conger eels (*Conger oceanicus*) occur from the coastal portions of estuaries to the edge of the continental shelf. In deeper waters they occupy burrows of the tilefish (*Lopholatilus chamaeleonticeps*). Between 1972 and 1974 we examined the stomachs and intestines of conger eels from inshore New Jersey (USA) waters ($n = 35$, with a total length:TL of 21 to 49 cm) and between 1980 and 1983 offshore ($n = 295$, 50 to 125 cm TL) collections. Eels from both areas fed primarily on decapod crustaceans and fish. The specific identity of prey items within these groups generally differed from inshore to offshore areas, probably reflecting the differences in prey availability. Foods of specimens collected offshore varied with size: smaller eels (< 80 cm TL) fed most heavily on decapod crustaceans, whereas larger eels (> 80 cm) consumed more fishes. The presence of some nocturnally active prey items in the gut, primarily the eel *Lepophidium cervinum*, suggests that conger eels are nocturnal feeders. This is supported by in situ observations that conger eels are present in some tilefish burrows during the day and are presumably out of burrows and foraging at night.

Introduction

The conger eel *Conger oceanicus* is distributed in coastal waters and over the continental shelf from Georges Bank (Valentine et al. 1980, Grimes et al. 1986) and Massachusetts (Bigelow and Schroeder 1953), south along the east coast of the U.S. into the Gulf of Mexico (Kanazawa 1958, Haedrich 1975). This species occupies "pueblo" habitats in the walls of submarine canyons (Valentine et al. 1980, Grimes et al. 1986) but also appears to be a common inhabitant of burrows excavated by tilefish, *Lopholatilus chamaeleonticeps,* in the Mid-Atlantic Bight (Able et al. 1982, Grimes et al. 1986). Recently we studied aspects of the age, growth and reproduction of this species in the same area (Hood et al. 1988). Although little is known of the food habits of the conger eel, the available information (Bigelow and Schroeder 1953) suggests that it may be an important predator at the edge of the continental shelf, as is its co-inhabitant, the tilefish (S. Turner and B. Freeman personal communication). This paper describes the food habits of the conger eel and discusses some aspects of spatial and temporal variation in feeding from collections in the Mid-Atlantic Bight.

Materials and methods

We examined the stomach contents of 330 individuals collected between 1972 and 1974 from inshore New Jersey (USA) waters, and between 1980 and 1983 from the edge of the continental shelf (Table 1, Hood et al. 1988: Fig. 1 for locations). All inshore collections were taken with small bottom trawls incidental to faunal surveys and preserved in 10% formalin. Individuals from offshore localities were collected by longlines fished for tilefish. The size of the hooks used in the longline fishery (Grimes et al. 1980) precluded the capture of small conger eels < 50 cm TL (Hood et al. 1988). Most individuals taken with longlines were preserved immediately in 10% formalin; others were held on ice until the stomachs and intestines were removed and then preserved.

Individual fish were measured to the nearest centimeter (total length, TL) and the contents of the stomach and intestine were removed and identified to the most precise taxonomic level possible and then weighed to the nearest 0.1 g after blotting with a paper towel. Care was taken to separate bait used on the longlines (usually squid) from actual prey items. Composition of the diet was determined as percent frequency of occurrence and the

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Table 1. *Conger oceanicus.* Prey from inshore and outer continental shelf areas of the Mid-Atlantic Bight. F: percent frequency of occurrence; NP: percent of total prey number; WP: percent of total wet weight of prey; IRI: index of relative importance

Taxonomic Group	Inshore				Outer continental shelf			
	F	NP	WP	IRI	F	NP	WP	IRI
Annelida								
Polychaeta unidentified	4.3	1.1	0.3	6.0	0.8	0.6	< 0.01	< 0.05
Mollusca								
Cephalopoda					6.9	5.3	17.5	157.3
Arthropoda								
Crustacea (Total)	91.3	71.3	39.1	10 079.5	42.7	43.2	12.0	2 357.0
Amphipoda	4.3	1.1	0.3	6.0				
Euphausiacea	4.3	1.1	0.3	6.0				
Stomatopoda								
Squilla empusa					4.6	3.6	2.6	27.1
Stomatopoda unidentified					0.8	0.6	< 0.01	0.6
Decapoda (Total)	47.8	26.4	22.4	2 332.6	30.5	33.7	8.4	1 284.1
Bathynectes superba					1.5	1.2	0.3	2.3
Cancer borealis	8.7	6.9	6.5	116.6	9.2	9.5	4.0	124.2
Cancer irroratus					2.3	1.8	0.4	5.1
Cancer sp.	4.3	1.1	0.3	6.0	1.5	1.8	0.6	3.6
Crangon septemspinosa	43.5	32.2	12.4	1 940.1				
Munida spp.					10.7	11.2	0.8	128.4
Pagurus longicarpus	21.7	10.3	7.5	386.3				
Porcellana sigsbaena					0.8	0.6	0.2	0.6
Brachyura unidentified	17.4	5.7	7.8	235.0				
Portunidae	4.3	1.1	0.6	7.3				
Xanthidae	4.3	2.3	0.3	11.2	2.3	1.8	0.6	5.5
Decapoda unidentified					3.8	5.9	1.8	29.3
Crustacea unidentified	13.0	9.2	3.1	160.0	6.9	5.3	0.8	42.1
Pisces (Total)	52.2	27.6	60.6	4 604.0	54.2	50.3	69.7	6 504.0
Anchoa mitchilli	13.0	4.6	18.9	305.5				
Conger oceanicus	4.3	1.1	5.9	30.1	5.3	5.3	21.1	140.0
Gobiosoma bosci	8.7	4.6	5.6	88.7				
Merluccius sp.					0.8	0.6	0.3	0.7
Morone sp.	4.3	1.1	8.7	42.1				
Ophichthus cruentifer					2.3	1.8	1.4	7.4
Syngnathus fuscus	13.0	9.2	14.3	305.5				
Urophycis sp.					0.8	0.6	2.6	2.6
Balistidae	4.3	1.1	2.5	15.5				
Gadidae					0.8	0.6	1.5	1.7
Eel unidentified					2.3	1.8	1.6	7.8
Flatfish larvae					0.8	0.6	0.1	0.6
Peprilus triacanthus					0.8	4.7	18.0	18.2
Helicolenus dactylopterus					1.5	1.2	0.5	2.6
Lepophidium cervinum					19.1	16.0	12.9	552.0
Pisces unidentified	17.4	5.7	4.7	181.0	22.1	17.8	10.5	625.4
Sampling period		1972 to 1974				1980 to 1983		
Number of stomachs examined		35				295		
Number of stomachs with food		23				131		
Length range of fish examined		21.2–50.0 cm				50.2–125.0 cm		

index of relative importance (IRI): $IRI = (NP + WP)\ F$ where NP is percent of total prey number, WP is percentage of total wet weight of prey and F is percent frequency of occurrence (Pinkas et al. 1971). We also present the data for percent of total prey number and percent of total weight used to calculate IRI as evidence that the index reflects actual prey utilization. We tested for seasonal and size-related differences in prey consumed, using the log likelihood test (G statistic) based on the number of individual prey types (Crow 1982).

In situ observations of conger eels and prey items, particularly *Lepophidium cervinum,* were made during Johnson-Sea-Link (JSL) submersible operations to study tilefish habitat ecology (Able et al. 1982, Grimes et al. 1986; personal observations (KWA) during similar operations in 1987).

Results

Based on the examination of over 150 stomachs with food, (23 inshore, 131 offshore) conger eels in the Mid-Atlantic Bight feed almost exclusively on decapod crustaceans and fish with cephalopods and other crustaceans of lesser importance (Table 1). Regardless of size, individuals from both areas shared several prey species including decapod crustaceans (*Cancer borealis,* xanthid crabs) and fish (*Conger oceanicus*), however most prey were different.

Regardless of size or location, conger eels fed to a large extent on elongate fish such as *Syngnathus fuscus, Lepophidium cervinum* and, to a lesser extent, on other conger eels and *Ophichthus cruentifer.* All conger eels fed on large prey items. Most individuals contained only one or two large prey items in their stomach. The inshore fish, which were smaller, fed heavily on fishes, such as *Anchoa mitchilli* and *Syngnathus fuscus,* and on decapod crustaceans, *Pagurus longicarpus, Crangon septemspinosa* and *Cancer borealis.* Offshore the diet was dominated by the crustaceans *Munida* spp. and *C. borealis,* the eel *Lepophidium cervinum* and to a lesser extent, cephalopods.

Larger conger eels fed less heavily on crustaceans (Fig. 1). When the number of food items was grouped by the two major prey types (i.e., crustaceans and fish) there were no significant differences for fish 20 to 49 cm TL relative to those 50 to 79 cm TL ($G = 3.27$, $\chi^2_{0.05} = 3.84$, df = 1). However, the largest size group, 80 to 110 cm TL, showed a significant, increased reliance on fish relative to the smaller size groups ($G = 19.7$, $\chi^2_{0.05} = 5.99$, df = 2).

Based solely on the offshore samples, the seasonal pattern of prey utilization varied with the size of the fish (Fig. 2). For the smaller individuals (50 to 79 cm TL), crustaceans (*Cancer* spp. and *Munida* spp.) appeared to be important in spring, but less so during other seasons, while fish were of primary importance during summer and the fall. For the larger fish (80 to 110 cm TL) crustaceans (*Cancer* spp. and stomatopods) were only important in spring and summer while fish were fed on almost exclusively in the fall and winter. *Lepophidium cervinum* was the only prey item found in both size classes during every season. The differences in these prey categories between

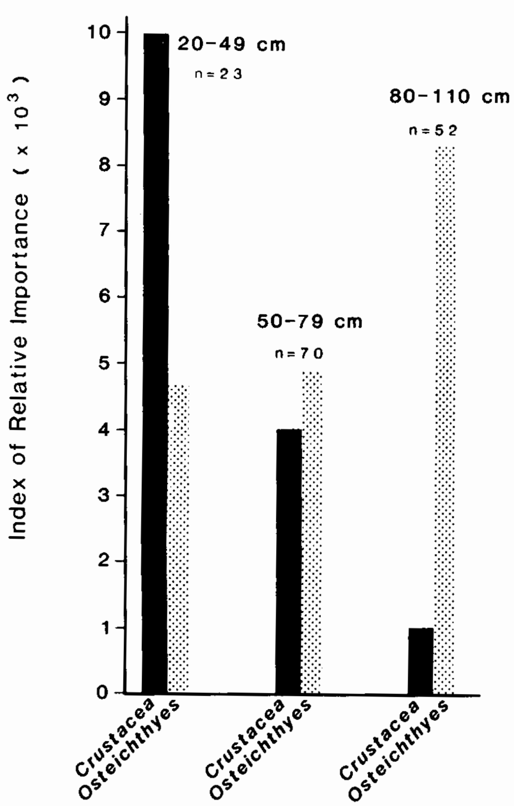

Fig. 1. *Conger oceanicus.* Comparison of major prey categories relative to conger eel TL for specimens collected in the Mid-Atlantic Bight

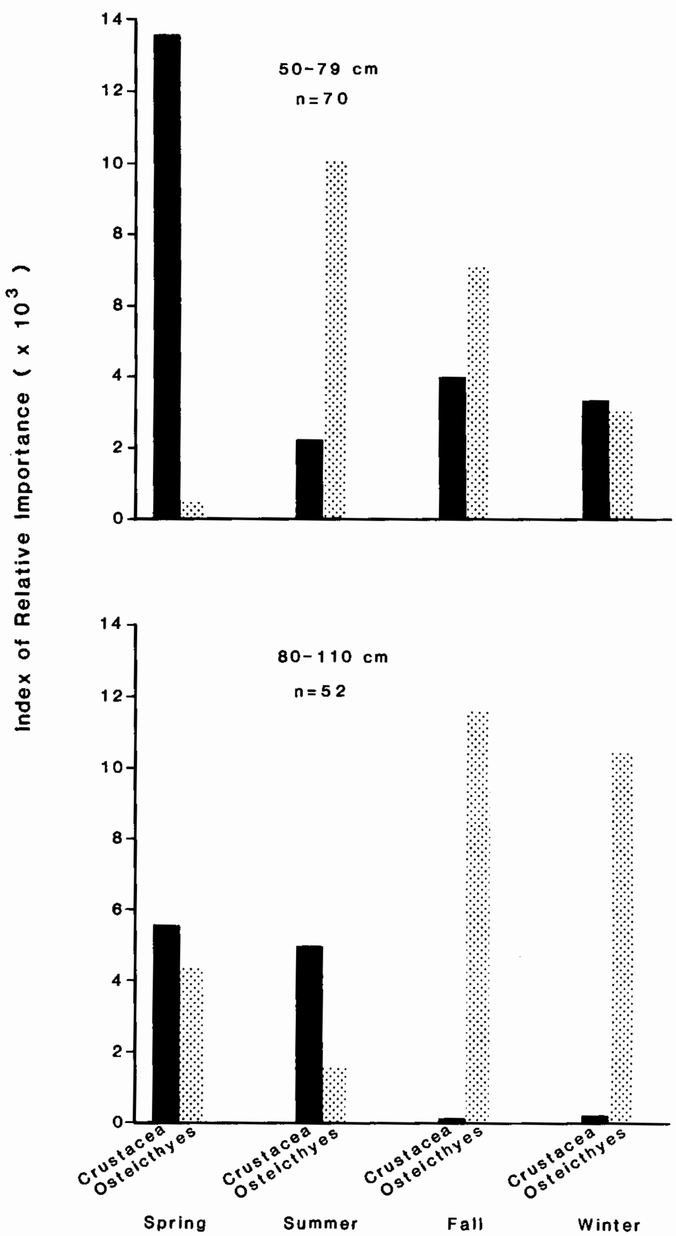

Fig. 2. *Conger oceanicus.* Seasonal variation of major prey categories for larger conger eels from offshore collections

the two size classes were significantly different in every season except the summer (spring – $G=5.21$, summer – $G=1.62$, fall – $G=6.52$, winter – $G=11.77$; for all seasons $\chi^2_{0.05}=3.84$, df = 1).

Discussion

The major classes of prey observed in conger eel stomachs, decapod crustaceans and fish, are similar to those listed by Bigelow and Schroeder (1953) who also reported several items we did not find (shrimp and small molluscs). Maurer and Bowman (1975) found echinoderms as well. *Conger conger* in the same size range, collected in the Mediterranean Sea, fed on the same major prey types (fish, crustacea and cephalopods) but fish dominated the diet (Cau and Marconi 1984).

The prey species eaten offshore, especially the larger macrofauna, are often observed in situ. For example, all decapods and fish had been observed from submersibles at the edge of the continental shelf and most of these were in, or in the vicinity of, tilefish burrows (Able et al. 1982, Grimes et al. 1986).

The diel activity patterns of some prey items suggest that conger eels forage at night. The most abundant fish prey, *Lepophidium cervinum,* has never been observed during daytime submersible dives in the general study area. However, nocturnal dives (JSL Dive 886, northwest of Veatch Canyon; JSL Dives 890 and 1 080, vicinity of Hudson Canyon) revealed large numbers of *L. cervinum* (3 to 5 m^2) emerging from the substrate or swimming over the bottom. Despite numerous dives we seldom encountered conger eels during the day, although on several occasions we observed them leaving tilefish burrows during the day after rotenone had been injected into the burrow to eject the occupants (JSL Dive 892, vicinity of Hudson Canyon). On one such occasion two conger eels were found in the same burrow occupied by a tilefish (JSL Dive 1 238, vicinity of Hudson Canyon).

Conger eels have been commonly observed in tilefish habitats (Able et al. 1982, Grimes et al. 1986) in the study area. To these observations we can add the co-occurrence of conger eels and tilefish under rock ledges in Baltimore Canyon (JSL Dive 1 427) and in burrows in Norfolk Canyon (JSL Dive 1 429). Thus, it is not surprising that there is some overlap in diet. Recent studies of tilefish food habits (S. Turner and B. Freeman personal communication) indicate that both conger eels and tilefish feed on cephalopods, *Munida* spp. and a variety of fishes including conger eels. However, the diet of tilefish appears to be much more diverse and includes, as important prey items, pelecypods, annelids, small decapods, and echinoderms, items not important in the diet of conger eels. The instances of cannibalism by conger eels and predation on conger eels by tilefish prompts the speculation that competition for vertical burrow habitat may be important. Burrow habitat at the edge of the continental shelf could be limiting because the fishery for tilefish (Grimes et al. 1980) has increased the number of abandoned, and thus silted-in burrows, in the period from 1979 through 1987 (personal observations).

Acknowledgements. A. Williams, National Marine Fisheries Service, Systematics Laboratory, assisted in the identification of many of the crustaceans. J. Applegate and G. Grossman provided helpful comments on an earlier draft. Captains W. Pettek, D. Booth and L. Puskus provided space on board their vessels. Additional samples were obtained from landings at Viking Village and Fishermen's Basin in Barnegat Light, New Jersey. This research was supported by a grant from Department of Commerce, NOAA Office of Sea Grant (Grant No. NA83AA-D-00034) and support from the Center for Coastal and Environmental Studies, Rutgers University. We are grateful to all mentioned above. This paper is New Jersey Sea Grant Publ. No. NJSG-86-147.

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Date of final manuscript acceptance: February 26, 1988.
Communicated by J. Grassle, Woods Hole